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ABSTRACT

Digital images have a rich potential as learning and teaching resources and are currently under-utilized in the support of pedagogical activities. The FILTER (Focusing Images for Learning and Teaching--an Enriched Resource) project is addressing this under-use and encouraging uptake of visual resources by mapping different types of images and defining the ways in which those images can be used to enhance the learning and teaching process. These categorizations form the basis of the main project deliverables: a generic image dataset, a set of subject-specific image datasets, and supporting documentation such as "how-to" guides and case studies. This paper describes the aims, objectives, and methodologies of the FILTER project. The project is based at the Institute for Learning and Research Technology, the University of Bristol, and started in May 2001. (Contains 20 references.) (Author/MES)

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FILTER: FOCUSING IMAGES FOR LEARNING AND TEACHING – AN ENRICHED RESOURCE

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Abstract

Digital images have a rich potential as learning and teaching resources and are currently under-utilised in the support of pedagogical activities. The FILTER (Focusing Images for Learning and Teaching – an Enriched Resource) project is addressing this under-use and encouraging uptake of visual resources by mapping different types of images and defining the ways in which those images can be used to enhance the learning and teaching process. These categorisations form the basis of the main project deliverables: a generic image dataset, a set of subject-specific image datasets and supporting documentation such as "how-to" guides and case studies. This paper describes the aims, objectives and methodologies of the FILTER project. The project is based at the Institute for Learning and Research Technology, the University of Bristol, and started in May 2001.

Keywords

images, digital images, learning, teaching, cross-disciplinary, collaboration

Introduction

It is known that a high level of expertise in image use already exists in certain subject areas, but possibly using a limited range of image types. However, as Williams, Lock, Crisp and Longstaffe (1995) have noted, there is currently no extensive body of information exploring the use of images in computer-based learning and teaching.

As more and more images become available over networks, it is crucial to take a collaborative approach to developing common standards for the creation and use of digital images (Hastings, 1999). The FILTER project (Focusing Images for Learning and Teaching – an Enriched Resource) is working closely with a number of Learning and Teaching Support Network (LTSN) subject centres to investigate aspects of image use in learning and teaching. The LTSN is a network of 24 subject centres based in higher education (HE) institutions throughout the UK. It aims to promote high quality learning and teaching through the development and transfer of good practices in all subject disciplines. The LTSN subject centres have an established direct route of communication and dissemination to practitioners, enabling FILTER to enter into dialogue with subject specialists in order to inform research processes and outcomes directly.

Each LTSN has varying levels of experience of image use; FILTER aims to enable a cross-fertilisation of these varying knowledge levels across subject disciplines, so that there are multiple learning opportunities for all involved. Transferral of expertise has a major role in the development of the main project deliverables: a generic image dataset and a set of subject-specific datasets containing: images, examples of image-based learning and teaching materials, supplementary thematic how-to guides and supporting metadata. This collaborative approach permits the identification and exploration of the factors of image use that are common to a number of subjects. Synthesis of this cross-domain

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knowledge sharing in the form of an exemplar database containing the image datasets will ensure maximum benefit to the widest possible potential HE and further education (FE) user-base.

FILTER's goal is to educate the tertiary education community on the potential for image usage; project research will focus on developing a better understanding of the use of images in learning and teaching. The project will provide case studies and exemplar digitisation and supporting materials to directly inspire usage of images in learning and teaching, with particular emphasis on subject areas where the use of images is comparatively underdeveloped and unexplored. Differences in learning and teaching styles across disciplines are well documented (Becher, 1989, 1994; Neumann, 2001). FILTER is investigating the ways in which these disciplinary differences affect perceptions of images and how they are currently used. By choosing a wide range of disciplines to research, FILTER aims to show that this work is applicable across subject areas and that therefore it will benefit learning and teaching in all subject domains.

Images in Learning and Teaching

It is known that learning is deeper and more effective when multiple senses are engaged in the learning process (McAteer & Shaw, 1995). It is also commonly accepted that users prefer and respond more positively to materials that contain visual elements (Duchastel & Waller, 1979; Levie & Lentz, 1982). Much research has been carried out establishing that recall and memory is improved when information is presented visually, or supplemented by use of images (Paivio, Rogers & Smythe, 1968; Standing, Conezio & Haber, 1970; Paivio, 1971, 1975; Standing, 1973; Faraday & Sutcliffe, 1997). However, it has been identified that there is a gap in the understanding and documentation of how to make the best use of images within learning and teaching materials (Williams et al., 1995).

Images are vital in our perception of the world: sight is primary among our senses, visual images have an impact and an information value that is unparalleled. The word 'image' is, in a sense, deceptive; a little reflection illustrates that there is, in fact, a significant number of different types of 'images' or pictorial/graphical representations.

FILTER is defining different image types to make the ways in which images can be used to support learning and teaching more transparent. In order to make the most appropriate use of images in educational materials and to greatly enhance the learning and teaching experience, the community must understand the different types of image available. However, academics outside disciplines which have typically used images widely may not always have the skills and perceptions which would allow them to make most effective use of visual data. This is particularly true of subject areas where images are not embedded in the learning and teaching process: images are traditionally an integral part of teaching in subjects such as the Visual Arts, Medicine or Built Environment, whereas teaching in Humanities subjects tends to be predominantly text based.

It is also important to note that in some subject areas images and their related taxonomies are clear aspects of scholarly practice, for example, the Medical Subject Headings scheme, or MeSH (U.S. National Library of Medicine, Online), in the biomedical disciplines. In others this sense of categorisation and taxonomy is less well developed. A key part of the project will involve developing an understanding of image usage and its function among different subject areas. The project clearly recognises that the notion of appropriate image usage must be driven by subject experts in order to inform and develop categorisations.

FILTER Approach

Timescales

In the first year, the project is working closely with a core set of LTSN subject centres. The subject centres have been commissioned to produce subject-specific image datasets and associated how-to guides and case studies, potentially choosing image types defined by the initial generic image set.

Activity	Jul Aug 01	Sep 01	Oct 01	Nov 01	Dec 01	Jan 02	Feb 02	Mar 02	Apr 02	May 02	Jun 02	Jul 02	Aug 02
Contract metadata specialists													
Database investigation													
Develop guidelines for generic dataset													
Investigation of image types													
Investigation of metadata													
LTSN focus group													
Research and literature review													
Web site development													
Consultative Forum													
Database development													
Draft generic dataset													
Focus group meeting													
Delivery of metadata report													
Final generic dataset													
Produce focus group report													
LTSN workshop													
Development of LTSN datasets													
Metadata schema/guidelines developed													
Database drafted													
Draft LTSN dataset due													
Usability testing of database													
Development of criteria for further sets													
Edit and return LTSN datasets													
Delivery of LTSN datasets													
Workshop with LTSNs													
Commission further 10 datasets													
Deliverables into database													

Figure 1: FILTER Project – timeline by activity start date, July 2001-August 2002

Also during this phase is the development of standards and methods for providing descriptive, subject-specific and learning and teaching-related metadata, which will enhance retrieval and ease-of-use of datasets. The final stage of this phase of the project involves the collation of the subject-specific image datasets and all associated materials such as the "how-to" guides, case studies and metadata, plus the generic image dataset, to form an exemplar database of image types and their use in learning and teaching.

In the second year a further ten sets will be commissioned across the broader subject areas. A general call out to the wider community, via the LTSN, will invite submissions for further subject-specific image dataset developments according to the criteria derived in the first phase. Priority at this stage will be given to datasets that fill a clear gap in subject area or type of image represented. In this way the project will be able to generate a comprehensive presentation for image use of relevance across the sector, underpinned by a cross-fertilisation of ideas and expertise from subject area to subject area. This also demonstrates that the project is a scaleable concept and could be expanded to commission more resources.

During the second year the contents of the exemplar database will be accessible via a number of routes: from the Technical Advisory Service for Images (TASI) Web site (Online), and also from the LTSN subject centre Web sites. Workshops and training activities will demonstrate how LTSNs catering for other subject areas could apply the models and materials developed. Primary participants will be LTSN representatives, but could also include interested parties from the wider tertiary education community.

Key Issues

The overall project aims are to enable the use of digital image datasets to support learning and teaching and to facilitate the integration of image resources with pedagogical practice. The project will provide a valuable mapping of images that will facilitate uptake in the use of visual data in educational contexts. Equally important, this type of mapping will help to provide a model of good practice by indicating appropriate use of different image representations coupled with the production of exemplar subject-specific image datasets.

The key research issues for the project are:

- Under use of images to support learning and teaching
- Inconsistent and uninformed use of images in some disciplines
- Lack of understanding of educational image use

When focusing on possible reasons for the current under use of images in an educational sense, there are three main considerations that arise:

1. There is currently no clear picture of the different categories or types of images that exist and how they inter-relate
2. There is little documentation of the ways in which these different categories of images can be used. For example, when might it be more appropriate to use a two-dimensional schematic map as opposed to a digital 'photorealistic' image? When is a real-time representation more informative than a series of stills? How much difference does a full colour image make as opposed to a simple grey-scale version? Decisions such as these are currently made intuitively, rather than against a set of clear criteria. Furthermore, appropriate use may be a simple decision for an "imaging expert", but as images become more widely used by a larger percentage of the teaching population, clearer guidelines are needed
3. There is a need for documentation of the ways in which images are being and can be used to support learning and teaching mapped against the different categories of images

Data Gathering

A critical element of the initial project research is the investigation and establishment of standards for issues underlying the creation and use of image databases: technical infrastructure, metadata schema, and best practice for image use. It is important for the project to gain as much comprehensive, diverse information on and insight into the issues surrounding current academic image use as possible. As well as reaching those who typically make high use of images, and have the technical skills and access to equipment that permit this, it is also crucial to reach those who make less use of images, for whatever reason. Therefore, project data is being collected in a number of ways, via a number of different routes that will allow the project contact with a range of practitioners.

Focus Groups

During the initial stage of the project, representatives from the LTSN subject centres attended a preliminary focus group that aimed to identify the different types of images that were currently being used (e.g. photographs, diagrams, schematic representations), and any commonalities in image use between disciplines. The list of image types derived from that meeting provides the foundation for an initial mapping of image categories and the ways in which they can be used to support the learning and teaching process.

The draft image map and generic image dataset will be taken to a practitioners' focus group, bringing

together key people within the community, from various subject disciplines, who are leaders in using all types of images within a learning and teaching context. The aim of this meeting is to discuss the categories and types of image (whether digital or not) that exist and to gain knowledge of how these images are currently being used in academic environments. The outcomes of these discussions will inform the refinement and definition of the draft generic image categorisation map, which subsequently will be supplemented by a number of subject-specific adaptations. The latter will include examples of the ways in which each category of image is used in learning and teaching. From this it will be possible to discern what roles different types of image perform, or have the potential to perform, in specific subject areas and what support is needed in the community to encourage the usage of other image types.

Questionnaire

The FILTER questionnaire examines academics' current use of images, such as what type of images are commonly used, which are found to be most effective and why and what, if any, obstacles prevent or discourage image use. The questionnaire was made available online but was also distributed by email and post. Using this method, the FILTER team is able to gather rich data about a range of image users from different subject areas, and with differing levels of technical skills. Questionnaire responses, following analysis, will be taken to the practitioners' focus group for general discussion. Analysis will focus on examining relationships between disciplines and image types used, and between image types and perceived effectiveness of teaching. Also important will be an identification of common factors that inhibit uptake of particular image types.

A high percentage of questionnaire respondents have expressed interest in becoming involved with the project and are participating in either focus groups, workshops, interviews, case studies or usability testing.

Case Studies

Case studies will have two formats. The first series of case studies will follow the development and creation of the subject-specific image datasets by the LTSN subject centres. In most cases these are being created by subject specialists who have been sub-contracted as authors by the LTSNs. The FILTER team will work closely with dataset authors at all stages of development. Of particular note will be the ease of access to suitable images, the planning and structuring of the resources and the process of dataset creation. It is important that these phases of development are closely monitored and documented, firstly so that formative evaluation can be fed iteratively back into the ongoing dataset development. Secondly, it is important for FILTER to gain insight into the conditions in which academics create learning and teaching resources and the issues that dictate choice of pedagogic style, materials, tools, and so on, so that the procedures can be analysed, tailored and refined for easy replication by other academics.

The second round of case studies will involve the participation of practitioners who have been identified from focus groups or the questionnaire, or have been recommended by the LTSNs. FILTER researchers will observe use of the resources as they are being developed - in the form of usability testing - and also after creation, in a number of ways. The resources will be tested from a practitioner's perspective for ease of use and comprehension and for ease of replication, but will also be tested in an educational setting for pedagogical effectiveness. For example, by comparing student test results when using image-based revision material with those when using text-based resources. Outcomes will again be fed formatively into the development of the datasets and the refinement of criteria and standards for the creation of the additional ten image datasets.

Emerging Research Factors

From preliminary research, key emergent factors in current educational image use appear to be:

- Insufficient time for locating suitable images
- Insufficient time to prepare images for teaching
- Lack of collections of free, copyright-free digital images for educational use
- Limited access to technical equipment in the workplace for both creating and displaying image-based resources
- Costs involved with producing image-based materials

- Limited access to digital images
- Lack of technical skills, and little time available to learn them
- Large sizes of image files leads to downloading, handling and storage problems
- Difficulty of sharing images in large teaching groups
- The effectiveness and 'impact' of an image
- Images facilitate different learning styles
- Importance of image use in teaching those with learning and physical disabilities
- Poor quality of some digital images

Research into these common factors will continue through the project using a variety of methods permitting FILTER to accumulate a substantial body of quantitative, qualitative and action-based research data. Data will be fed back formatively into the development of standards and criteria for the image dataset creation, as well as the development and use of the datasets themselves.

Image Mapping

The following example illustrates the different types of image, in this case of a house, which could exist. It shows the richness of the concept of an image and clearly demonstrates that each of the image types could be used to support the learning and teaching process in very different ways.

Central to the set is the digital image of a photograph of the house. Underlying this resource are other types of 'images' available as learning and teaching resources, for example:

- A rough sketch of the house, outlining broad features, size and style
- A table of data showing previous owners/occupations/dates of ownership
- Numerical data, e.g. a table or graph showing square metres of rooms
- Associated text – an image of a page of text showing the deeds of the house, the survey and so on
- A schematic representation, such as the architectural plans of the house, flow chart of construction (either vector or raster representation)
- A macroscopic perspective, showing the house in context in terms of the street, town, country, continent
- A microscopic perspective looking at increasingly finer details of the house, from structure, to room, to microscopic images of building materials such as concrete, wood, tiles or bricks
- A multi-spectral image such as an aerial/satellite image of the house taken in different spectral wavelengths
- A 3-dimensional model of the house
- A virtual reality version of the house, for example providing the opportunity to take a tour of the house or a reconstruction through time showing stages of construction.

These images could either be: on 'conventional' media (e.g. paper, or an overhead projector transparency); 'born digital' (e.g. through a 'paint' type programme); or made digital through digitisation (e.g. a photograph that has been scanned).

Subject-specific Image Datasets

An exemplar subject-specific image dataset is defined as:

- A set of images typically used in that subject discipline
- "How-to" guides and/or case studies of how the exemplar images can be used to enhance learning and teaching within that subject
- Metadata that will link together technical, pedagogical and subject-specific information in such a way as to support and enable use by learners and practitioners.

These subject-specific image datasets will include as many different types of image as is feasible. An academic could take this model and adapt it to her/his own subject-specific requirements. This image dataset will be used together with the case studies or "how-to" guides to illustrate the

contexts in which it is most appropriate to use a particular image type.

Metadata is particularly important for images as without accurate description there can not be accurate retrieval (Rorvig, 1999). Visual material requires description of a greater depth than textual resources in order to gain an understanding of its complexity and the implicit multiple layers of meaning and content (Turner, 1999). Describing images is further complicated by the nature of the material: it exists in pictorial form rather than in verbal terms. An investigation of image metadata is being carried out on behalf of FILTER by the UK Office for Library Networking, UKOLN (Online), renowned experts in the area of metadata research. UKOLN will produce a report for FILTER including recommendations and templates for the application of metadata. These recommendations will form part of the underlying technical standards for the exemplar database creation.

Each dataset will include, associated with it, appropriate "how-to" guides and/or case studies. The "how-to" guides will provide practical and easy-to-use step-by-step guidance on using and integrating the image resources into learning and teaching materials. The guides will be themed and incorporate issues of pedagogical and technical relevance. They will be available in Web and print format to ensure maximum usage. The guides are likely to cover the following topics, although exact details will arise from the collection themselves:

- Ideas for using specific image types to engage students in debate
- Topics suitable for exam questions
- Themes and issues arising from the collection
- Encouragement for students to use the resource
- Using the resource to support student workshops or projects
- Using the images to support lecturing and presentations (PowerPoint, Web delivery, etc.)
- Using the images in paper-based documents
- Using the images to initiate online discussion
- Ideas for using the images in collaborative learning
- Enhancing student materials by incorporating the images into computer-based learning
- Technical use of the images, e.g. for use in content-based retrieval.

Conclusion

It is known that a high level of expertise in image use already exists in certain subject areas, but possibly using a limited range of image types. The FILTER project is enabling, by working closely with a variety of LTSN subject centres, a cross-fertilisation of this knowledge across subject disciplines, so that there are multiple learning opportunities. This approach permits the research team to explore the factors of image use that are common to certain subjects. Synthesis of this cross-domain knowledge sharing in the exemplar database will ensure maximum benefit to the widest possible potential user-base.

This initiative to investigate and understand the appropriate use of images within learning and teaching is both pertinent and timely. The creation and delivery of large digital image datasets via the Web presents opportunities for the Education community. To benefit from investment in such resources, there is a need to ensure that the community understands what image resources are available and how they are best incorporated with existing and any future learning materials.

It is also essential to understand the nature of the primary factors currently hindering the use of images within learning and teaching. Integration of digital resources with curricula should be driven by educational need rather than the availability of technology or the influence of institutional policies (Hagdrup, Edwards, Carter, Falshaw, Gray, & Sheldon, 1999), and that development should be user-driven. Through research and investigation into the diverse pedagogical aspects of image use, FILTER will achieve an understanding of how best images may be utilised across a wide range of disciplines. These findings and outcomes will be refined into a set of guidelines and standards that can be adopted across disciplines, facilitating easy use and

exchange of image information. At completion of the project, FILTER will be ideally placed to identify areas of image use for further research and investigation.

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